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Training for Inspection and Maintenance Programs

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Technical Report

Training for Inspection and Maintenance Programs

by

Audrey F. Chijner

April 1981

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Technical Reports do not necessarily represent final EPA decisions of positions. They are intended to present technical analysis of issues using data which are currently available. The purpose in the release of such reports is to facilitate the exchange of technical information and to inform the public of technical developments which may form the basis for a final EPA decision, position or regulatory action.

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U.S. Environmental Protection Agency
Ann Arbor, Michigan

Training for Inspection and Maintenance Programs

Introduction

The successful implementation of an I/M program requires that certain people undergo training. The purpose of this report is to provide guidance to I/M program administrators on the development of training for inspectors, auditors, investigators, and mechanics. The report will review the experiences and problems encountered by currently operating I/M programs and provide recommendations as to course content and coordination of training efforts.

Inspector Training

Inspectors do the actual testing of vehicles in both centralized and decentralized facilities. The basic knowledge and skills necessary for an I/M inspector include the following:

- I/M test procedures
- instrument use and calibration procedures
- data collection & reporting
- program rules, regulations, and other items required by the state, local, or regional authority

Of all the existing inspector training programs, the one conducted by Oregon's Department of Environmental Quality (DEQ) for its state-operated, centralized program is the most extensive. It is a formal, week-long training program for state inspectors which uses slides accompanied by a tape recording and a procedures manual. In addition to the those listed above, topics covered include: the background of the program, air pollution causes and controls, how to release hoods on different vehicles, and clerical skills and handwriting. Between 20 and 50 people are trained per year in the program, which has been accredited by Clackamas Community College. In addition, Oregon offers a 2 1/2 day training program for fleet inspectors. This program is similar to the state inspector training program except that there is less emphasis on the background of the program and on the personnel aspects.

When New Jersey added an emissions inspection to its centralized safety test lanes, several day-long sessions were held on the use and maintenance of the infrared analyzers. Similar training for inspectors in the Cincinnati program was provided by the analyzer manufacturer. Arizona's contractor trains the inspectors in the central test lanes, and the state's Bureau of Motor Vehicular Emissions trains fleet inspectors in a seven hour course.

Training can be provided by either the administrating agency or source(s) approved by that agency. Many states are utilizing vocational/technical schools and community colleges to offer training classes. The National Center for Vehicle Emissions Control and Safety at Colorado State University (CSU) has developed, through an EPA grant, an inspector training course which is available to schools and colleges. CSU can also be hired to conduct workshops to train instructors to present the course.

The CSU course provides general information about automotive emissions and their control. (See Appendix A for course outline.) The section on emission control technology attempts to give inspector trainees a basic understanding of the subject which can be further developed should they be required to perform a cursory tampering inspection. The format includes slides, workbooks and hands-on laboratory demonstrations and exercises.

The course places great emphasis on the proper use and maintenance of the exhaust gas analyzer. It is designed such that the instruction applies to most analyzers on the market. State or local users of the course may wish to substitute a specific analyzer model and to follow the manufacturer's operation and maintenance instructions. State or local information may also be included in the section concerning data recording, and there is one section specifically for local rules, procedures, etc.

In centralized contractor-run programs, the contractor frequently will provide training. Also, instrument manufacturers often have training programs on the use of their equipment. These courses could be expanded to include the necessary additional information on the I/M program requirements.

Inspector Proficiency Testing

The July 17, 1978 memorandum from David G. Hawkins titled "Inspection/ Maintenance Policy" states that "a representative of the [licensed inspection] facility must have received instructions in the proper use of the instruments and in vehicle testing methods and must have demonstrated proficiency in these methods." As mentioned previously, proficiency for an inspector includes having skills and knowledge in the following areas:

- I/M test procedures
- instrument use and calibration procedures
- data collection & reporting
- program rules, regulations, and other items required by the state, local, or regional authority

Proficiency may be demonstrated in any of several ways. The administrating agency can provide testing or authorize another organization, such as an I/M contractor, an instrument vendor or a community college, to develop and/or administer a test. The test itself may be oral or written and should include a demonstration of instrument calibration, testing and data recording procedures. The demonstration could take place at a learning facility or at the inspection site. Certificates may be issued to those inspectors who successfully demonstrate proficiency in the aforementioned areas.

It is recommended that in a decentralized program, a "certified" inspector, one who has demonstrated proficiency, do the testing, or at least be present when emissions inspections are being performed. To ensure that there is always someone qualified to use and maintain the analyzer, it would be preferable that more than one employee at each inspection station be trained and certified.

It is also recommended that inspectors be retested every three (3) years to assure that their knowledge and skills are kept current. The administrating agency should maintain an up-to-date list of trained inspectors and use this list to disseminate information on changes in I/M program requirements, etc. Also, as part of the unscheduled/unannounced or monthly audits in decentralized programs, the investigator could require inspectors to perform a "hands-on" proficiency demonstration of an actual I/M test, the calibration check of the analyzer, etc.

Investigators

The role of the investigator is to audit inspection stations and provide the quality control function to the program. The investigator will usually be a state or local government employee who conducts audits on independent testing stations, fleet self-inspection operations, contractor-run stations or self-audits on state-run inspection lanes. Activities that this position may include are checking instrument calibration, verifying that recordkeeping and all other procedures are being followed properly, supervising "hands-on" testing of inspectors, and investigating complaints.

In most existing programs, station investigators already have an automotive and enforcement background, or they are trained by working with experienced investigators. However, in some of the programs training is conducted for the investigators. When New Jersey implemented its private garage reinspection program, about 45 former safety inspectors were trained in calibration procedures, rules and regulations, and investigation techniques. In Rhode Island, garage investigators, along with other personnel in the administrating agency's inspection department, are required to participate in a training program. Although the major emphasis in this training is on safety, the training also addresses analyzer calibration procedures and problems as well as the causes of high HC and CO emissions.

The audit function is a requirement (as stated in D. G. Hawkins's July 17,1978 memo titled "Inspection/Maintenance Policy") for decentralized I/M programs. Although there is no training requirement for investigators, this training needs to be available. States may also want to require investigators to pass a test of proficiency.

Training for investigators can be provided through the same means as for inspectors. An investigator course will be developed by CSU in Fall, 1981. This course, as well as an instructor's guide, will be available at that time. This course will include all elements of the inspector course and additional information in the following areas:

- gases and gas calibration procedures
- audit procedures and forms
- inspector certification procedures
- any other tasks to be performed according to state/local rules

Mechanic Training

The emission control devices on today's cars are sophisticated systems which are integrated into almost every aspect of the vehicle's engine and total performance. In areas with Inspection/Maintenance (I/M) programs, it is especially important that the automotive service industry have the proper knowledge about vehicle emissions and emission control systems. Mechanic training programs in I/M areas are important for the following reasons:

1. Training is valuable in order to teach local/state program requirements and the need for I/M. The mechanic that understands the purpose of the I/M program should be better motivated to provide the most effective repairs. This hopefully will result in a better functioning program.

2. I/M non-compliance imposes a liability on the consumer. The mechanic is now responsible for more than just service; he or she becomes an arm of the government, and the accuracy and fairness of the tests and repairs are critical to the effectiveness of the program. Proper training should reduce the cost and time of repairs and the frequency of unnecessary repairs and readjustments (particularly during the early part of the program). There should be less "ping-ponging" (the consumer repeatedly going back and forth between testing and repairs) because the trained mechanic should be able to make the correct repairs. There should also lead to fewer waivers being granted which should increase the I/M program effectiveness.

3. Proper public contact is important. The inspector is frequently the only personal contact the public has with the program, and he or she can have a large impact on the public's perception of the I/M program.

4. Properly performed repairs should mean better driveability, lower exhaust emissions and better fuel economy over time.

5. Vehicle emission control technology is complex and continually changing. Non-dealership mechanics will have to understand the new computer-controlled technology, and a forum must exist to transfer this new information to the field and to update the skills of practicing mechanics.

Currently, Oregon, Arizona and California sponsor some form of mechanic training. New Jersey trains instructors in vocational schools to use an educational package developed by Colorado State University. Although Nevada does not sponsor mechanic training programs, a person must pass a written and hands-on test as well as show proof of completion of an automobile mechanic's training course in order to become a certified inspector.

Arizona has approached mechanic training in several ways. Like New Jersey, Arizona conducts workshops to train vocational education instructors. Currently, Arizona also conducts training seminars for both mechanics and the general public. In addition, Arizona conducts a special training program aimed at correcting the high number of carburetor maladjustments made by tune-up mechanics. Performed at the repair facilities, this program includes

a demonstration of the propane enrichment technique for carburetor adjustments. Arizona officials also make about four contacts each day with individuals and repair facilities concerning specific maintenance problems or procedures.

The Oregon DEQ sponsors a mechanic training course which uses the Colorado State University curriculum. The DEQ also maintains contact with vocational schools and community colleges in order to keep auto repair instructors up to date about state inspection requirements and emission control technology. No formal licensing is required of mechanics, and DEQ personnel feel that this is a problem because it diminishes the mechanic's incentive to attend training courses. Also, there is sometimes a problem getting the mechanics who particularly need the training to attend the courses. (Other areas have expressed similar concerns over the lack of licensing.) There are no refresher requirements, but supplemental courses are available.

Nearly a year before the start of its I/M program, California conducted seminars to familiarize automotive mechanics with the requirements of the program. This was done to ensure that there would be a sufficient number of qualified persons available to perform repairs on the failed vehicles. The seminars were conducted throughout Southern California in each of the six affected counties. Topics covered in the seminars included emission control system diagnostic techniques and repair procedures and proper tune-up procedures. A written examination on the topics covered was given to mechanics who attended the seminar, and only mechanics who passed the test received Certificates of Qualification (which are valid for three years).

Since the start of the I/M program, California has continued to conduct the qualification seminars. Mechanics who fail the examination may obtain additional training at various educational institutions. An official training package approved by the State Department of Education and comprised of visual aids, narrative, and demonstrations is available at 23 educational institutions in southern California, including community colleges, adult education programs, private schools, and regional occupational programs.

Several of the areas with mechanic training programs promote voluntary mechanic certification through the National Institute for Automotive Service Excellence (NIASE). NIASE is a non-profit organization that administers tests to certify mechanics and it has been endorsed by most of the automobile manufacturers. Although NIASE certification is not primarily directed at I/M-related repairs, its engine tune-up examinations do address the diagnosis of emission control system problems.

Petroleum and automobile manufacturers sponsor in-house training programs for mechanics. Also, community colleges and vocational schools have established mechanic training programs. (See Appendix B for a list of sources for training.)

Mechanic training is especially important in I/M programs to ensure that cost effective repairs are made, and for consumer protection, convenience and confidence. EPA has worked with Colorado State University (CSU) to develop specific courses for mechanics who will be involved with I/M programs. These courses inform the mechanic about the emissions control systems, the causes of

vehicle pollution, how to use the infrared (I/R) analyzer as a diagnostic and repair tool, and a procedure to quickly find and repair the causes of excessive emissions. (See Appendix C for course outline.) These courses have been tested in the field and have been well received. States and local areas wishing to provide training are encouraged to make use of these courses. For those wishing to develop their own training curriculum, certain elements should be addressed:

- Proper analyzer operation and calibration;
- Local I/M program requirements;
- Basic information on types of I/M failures;
- Diagnosis and repair of excessive hydrocarbon and carbon monoxide emissions, including procedures for proper adjustment of carburetors and/or fuel metering systems.

The training should emphasize hands-on demonstrations of the necessary repair techniques, especially of the carburetor adjustment, which is the most common form of I/M repair.

Fuel Savings from Mechanic Training

The incremental fuel savings achievable through a formal mechanic training program will depend on the type of repair approach used in the I/M area. The fuel economy benefit for a pre-1981 vehicle which fails I/M and is repaired by a trained mechanic is estimated to be 0.8% for conventional training programs. Training results in mechanics performing certain types of repairs which improve fuel economy; however, other repair practices which may degrade fuel economy remain. The net effect is a 0.8% fuel economy improvement which is attributable to training. For I/M programs and training programs which result in repairs consisting of only carburetor adjustments (and other types of repairs which do not degrade fuel economy), the fuel economy benefit has been shown to be 4% per failed vehicle.

These mechanic training benefits for pre-1981 repaired vehicles are based on data from EPA studies. The benefit of 0.8% is taken from two sources: a mechanic training study in Portland and an analysis of repaired I/M vehicles with repairs other than grossly maladjusted ignition timing settings in the "retarded" direction. The latter analysis is relevant in estimating mechanic training benefits because proper ignition timing adjustment is an important aspect of mechanic training. The sources each yielded a fuel economy benefit of 0.8% for failed vehicles.

The benefit of 4% for failed vehicles receiving only carburetor adjustments is based mainly on an EPA study in Houston in which contractor personnel repaired vehicles by adjusting the carburetors to a specific idle CO level. This is a practical and realistic approach which yields full CO emission reduction benefits and partial, but substantial, HC emission reduction benefits. This approach may not require extensive mechanic training; a very brief training course and/or an enforcement mechanism to assure that the vehicles are set to the proper idle CO level and to discourage or eliminate repair practices which

degrade fuel economy may be all that is necessary. Several other EPA studies confirm the ability of repairs to result in a 4% improvement. Although repairs were often extensive in these latter programs, carburetor adjustments were the most common repairs performed and were responsible for most of the fuel economy benefit. The figure of 4% appeared repeatedly in these programs.

No deterioration of the above fuel economy benefits between inspections is anticipated. This conclusion was reached from an analysis of vehicles which were tested quarterly for a period of one year after they received repairs to pass the I/M test in Portland. Data from 93 repaired vehicles which had a mean fuel economy increase due to maintenance showed no loss in fuel economy during the following year. The fuel economy was very stable and level throughout the time period.

No additional fuel economy benefit from mechanic training over the basic I/M benefit is expected for 1981 and later vehicles. This is because even without training, mechanics must correctly and fully repair these vehicles' fuel systems in order for them to pass the I/M reinspection.

Table 1 shows the incremental fuel savings for pre-1981 vehicles (averaged over five years) from mechanic training. The high end of the range of savings is based on the 4% benefit for failed vehicles receiving only carburetor adjustments and is available in I/M programs which achieve this type of repair through training or some other means.

Table 1

Incremental I/M Annual Fuel Savings per Inspected Vehicle from Mechanic Training

Dollar Savings	Fuel Savings	Nationwide Gallons Saved (Millions)
$0.83-$4.18	0.09-0.46%	26.2-130.2

Establishing a Mechanic Training Program

The planning, development and implementation of I/M-related mechanic training programs requires the cooperation of many organizations. At the outset, a lead training agency should be designated, and one person should have coordination responsibility. It would be fitting that this be the same person coordinating inspector and investigator training.

Before designing a mechanic training program, it will be beneficial to assess the scope, attitudes and needs of the affected parties. The following steps are recommended for the assessment of mechanic training needs:

1) Interview local interest groups, soliciting their ideas and resources.

2) Conduct a preliminary workshop with members of automotive trade organizations, educators, agency personnel and consumer groups.

3) Survey the automotive service industry to determine the type of repairs being performed, the type and level of previous training, geographic distribution of repair and training facilities, equipment capabilities and general knowledge of I/M.

4) Survey local school and technical training centers to determine their willingness to participate in a specialized mechanic training effort.

From this assessment of needs, the lead training agency can establish a task force selected from the interested governmental and private groups. The role of the task force should be to determine the basic design of the mechanic training program. The design criteria include:

1) Selection of target audience to train (i.e., initially tune-up mechanics);

2) Selection of a course curriculum, including any modifications to meet state or local needs;

3) Selection of a testing mechanism if one is used; and

4) Selection of when, where, how often and by whom training is offered.

Appendix D is an example of a Needs Assessment Survey which was prepared by Colorado State University for Albuquerque, New Mexico. A study of this type could be conducted by the state/local government or could be contracted to another organization. The information that is gathered should provide the basis for a mechanic training program which is specific to the area and best meets the needs of area mechanics. It also should provide a determination of the number of mechanics in the area requiring training.

Needs assessment surveys and other services offered by CSU are available to states either by direct contract with CSU or through a grant EPA has with CSU. To use the grant, states can redirect Section 105 Air Grants back to the EPA Regional Offices, who can commit the funds to the grant for the states' uses. A list of the courses offered and other materials available through the CSU Grant is provided below.

Training Courses Conducted by CSU

- Mechanic Instructor Course (40-hour course and 24-hour course)
- Inspector Instructor Course
- Tampering Detection Course
- Mechanic Training Program Planning Workshops
- Public Awareness Workshops and Demonstrations
- Investigator Instructor Course (Fall, 1981)

Materials Available from CSU

- Federal Course on Emission Systems Diagnosis (16-hour course) - Student Workbook

- Instructional Materials Packet (40-hour course) - This course is to train instructors to teach the 16-hour course. It includes an instructor's guide, transparency masters, slides and audio tapes, handouts, laboratory exercises, pre/post tests and evaluation instruments.

- Motor Vehicle Emissions Control - Self-instructional books and tapes

- Primer on Auto Emission Systems for the Home Mechanic - Book.

- Tampering Detection Course - Student and instructor workbooks

Additional information about these courses and services can be obtained through I/M contacts in the Regional Offices or directly from the National Center for Vehicle Emissions Control and Safety at CSU in Fort Collins, Colorado 80523.

Emission Credits for Mechanics Training

The computer models MOBILE1 and MOBILE2 can be used to determine the additional emission reductions from an I/M program which incorporates mechanic training. If additional emission reductions for mechanic training are claimed in the SIP, certain reporting is necessary to determine the amount of appropriate credit. Incremental mechanic training emission reduction credits must be based on some measurement of the number of failed vehicles in the I/M program which are repaired by trained mechanics. In the absence of mechanic licensing and elaborate recordkeeping, it is not possible to actually measure the portion of vehicles which are repaired by trained mechanics. Some percentage of failed vehicles will not be repaired by the service industry, but rather by the vehicle owner. Thus, the mechanism for determining the emission credits must be based on certain projections. To receive additional credits for mechanic training, administering agencies will need to:

- Provide training which addresses the curriculum elements previously described;

- Provide an estimate of the percentage of the service industry which will have received training as of 1987; and

- Project the portion of the failed vehicle population in 1987 which will be repaired by the service industry.

Using these projections, incremental emissions credits then will be based on the final estimate of the percentage of failed vehicles repaired by trained mechanics.

Appendices:

A - Inspector Course Outline
B - List of Sources of Training
C - Mechanic Training Course Outline
D - Albuquerque Needs Assessment

Appendix A

Inspector Course

Outline

UNIT ONE: INTRODUCTION

Learner Objectives
Air Today
Air Pollution Problems
    Smog
    Ozone
    Hydrocarbons
    Carbon Monoxide
    Oxides of Nitrogen

UNIT TWO: AUTOMOTIVE EMISSIONS CONTROL

Learner Objectives
Formation of Hydrocarbons
Formation of Carbon Monoxide
Formation of Oxides of Nitrogen
Hydrocarbon (HC) Emissions Control
    Crankcase Emissions Control
    Fuel Evaporation Emissions Control
    HC Exhaust Emissions Control
Carbon Monoxide (CO) Emissions Control
Oxides of Nitrogen Emissions Control
Legislation Related to Air Pollution Control
    Background Information
    Inspection/Maintenance Programs for Air Pollution Control
        Centralized I/M Program
        Decentralized I/M Program

UNIT THREE: THE VEHICLE EMISSIONS INSPECTION: PROCESS AND TOOLS

Learner Objectives
Types of Emissions Tests
    Idle Mode Test
    Idle-2500 RPM Test
    Loaded Mode Test
Use of the Infrared Analyzer in Emissions Inspections
    General Description
    I/R Analyzer Meters
        Hydrocarbon (HC) Meters
        Carbon Monoxide (CO) Meters
    Preparing to Use the I/R Analyzer
        Mechanical Zero
        Warm-up
        Electrical Zero

- Electrical Span
- Static Electricity
- Aspirator and Water Trap
- Flow Indicator

Sampling With the I/R Analyzer
- Vehicle Exhaust Leaks
- Vehicle Warm-up

Sample Probe Insertion
I/R analyzer Maintenance Procedures
- Aspirator and Water Trap
- Filter Life
- Sample Probe and Hose
- Gas Calibration

Demonstration Exercise 1: I/R Analyzer
Demonstration Exercise 2: Gas Calibration

UNIT FOUR: REPORTING PROCEDURES

Learner Objectives
Vehicle Identification Methods
Test Results and Standards
- Comparing Test Results With Standards

Demonstration Exercise 3: Vehicle Identification and Reporting

UNIT FIVE: MANUFACTURER'S EMISSIONS WARRANTY PROVISIONS

Learner Objectives
- Emissions Design and Defect Warranty
- Performance Warranty

UNIT SIX: CURSORY TAMPERING INSPECTION

Learner Objectives
Common Sources of Tampering
- Catalytic Converter
- Fuel Filler Restriction
- EGR Valve
- Air Injection System
  - Air Pump System
  - Pulse Air System
- Thermostatic Air Cleaner

Demonstration Exercise 4: Cursory Tampering Inspection
- Cursory Tampering Inspection Chart

UNIT SEVEN: PUBLIC RELATIONS: THE INSPECTOR'S ROLE

Learner Objectives
- Personal Appearance
- Meeting and Greeting the Customer
- Relating to the Customer
- Proper Farewell

Local Unit: Suggested Topical Outline: Personnel Orientation Review
Appendix A - Sources for Manufacturer's Emissions Control Manuals
Appendix B - Public Information Materials Available From EPA
Appendix C - Glossary

Appendix B

Sources of Mechanic Training

There are many sources of training which have been established for automotive service industry personnel. Among these are the following:

- National Center for Vehicle Emissions Control and Safety, Colorado State University, Fort Collins, CO 80523 (303) 491-5278/7240.

- New Automobile Dealers Association, 8400 Westpark Drive, McLean, VA 22102, (703) 821-7233.

- Automotive Service Councils, 188 Industrial Drive, Suite 112, Elmhurst, IL 60126, (312) 530-2330.

- Equipment Vendors
  Various companies, i.e. Sun Electric, Marquette, Hamilton Test Systems, Siemens Corporation, etc. Contact local sales representatives for details.

- Vehicle Manufacturers
  All domestic and foreign manufacturers maintain training centers throughout the country.

- Aftermarket Parts Manufacturers
  Several companies, i.e. AC/Delco, Champion, etc. offer training courses at various locations for independent service personnel and the general public.

- Motor Age Magazine and various other publications often include self-instructional training modules for their readers.

- Local Community Colleges, Vocational Centers and High Schools are probably the best source of training facilities due to availability of equipment and staff.

Appendix C

Mechanic Training Course

Outline

UNIT I - INSPECTION/MAINTENANCE PROGRAMS AND VEHICLE EMISSIONS

Learner Objectives
Purpose of Inspection Maintenance (I/M) Programs
Federal Government Involvement
Service Industry Role
State and Local I/M Programs
Local I/M Program Requirements: General
    Requirements and Rules That Affect Owners and
    Automotive Service Technicians in Local I/M
    Programs
Detection of I/M Failures - What Do We Test For?
Types of Emissions Inspection Failures
What Are HC Emissions?
What Are CO Emissions?
What Are The HC and CO Relationships?

UNIT II - EQUIPMENT USED IN THE INSPECTION AND CONTROL OF EMISSION LEVELS

Learner Objectives
Background Information
Infrared (I/R) Exhaust Gas Analyzer
Preparing To Use The I/R Analyzer
Sampling With the I/R Analyzer
Demonstration Exercise 1
Infrared Analyzer Maintenance
Demonstration Exercise 2
Additional Readings Used To Supplement The I/R
    Analyzer During Diagnosis
Testing Vehicles Equipped With Catalytic
    Converter And/Or Air Pump

UNIT III - I/M FAILURE: EXCESSIVE HYDROCARBON EMISSIONS

Learner Objectives
Unit Introduction
Background Introduction
General Problem Area: Ignition System Malfunctions
Ignition System Malfunctions: Probable Causes
General Problem Area: Ignition Timing Defects
Ignition Timing Defects: Probable Causes
Demonstration Exercise 3
General Problem Area: Vacuum (Air) Leaks
Vacuum (Air) Leaks: Probable Causes

General Problem Area: EGR System Malfunctions
EGR System Malfunctions: Probable Causes
General Problem Area: Lean Carburetor Misfire
Lean Carburetor Misfire: Probable Causes
Demonstration Exercise 4
General Problem Area: Mechanical Engine Defects
Engine Defects: Probable Causes
Unit Summary: Excessive Hydrocarbon Emissions
Table 1 - Excessive HC Emissions: Other Symptoms Likely to be Present With Each General Problem Area
Correction Exercise #1: Correction Procedure For Excessive HC Emissions
HC Diagnostic Reference Chart #1
HC Diagnostic Reference Chart #2
HC Diagnostic Reference Chart #3
HC Diagnostic Reference Chart #4
HC Diagnostic Reference Chart #5

UNIT IV - I/M FAILURE: EXCESSIVE CARBON MONOXIDE EMISSIONS

Learner Objectives
Unit Introduction
Background Introduction
General Problem Area: Air Intake Restriction
Air Intake Restriction: Probable Causes
General Problem Area: Crankcase Ventilation Enrichment Effects
Crankcase Ventilation Enrichment Effects: Probable Causes
General Problem Areas: Improper Carburetor Idle Speed and Idle Mixture Adjustments
Improper Carburetor Idle Speed and Idle Mixture Adjustments: Probable Causes
General Problem Area: Internal Carburetor Malfunction
Internal Carburetor Malfunction: Probable Causes
Table 1 - Excessive CO Emissions: Other Symptoms Likely to be Present With Each General Problem Area
Demonstration Exercise 5
Correction Exercise #II: Correction Procedure For Excessive CO Emissions
CO Diagnostic Reference Chart #6

UNIT V - I/M FAILURE: EXCESSIVE HC AND CO EMISSIONS

Learner Objectives
Background Introduction
General Problem Area: Excessively Rich Mixture
General Problem Area: Rich Mixture and Another HC Related Problem
Repairing a Vehicle With Excessive HC/CO Emissions
Post Combustion Emission Control systems
Table 1 - Excessive HC Emissions: Other Symptoms Likely to be Present With Each General Problem Area

Table 2 - Excessive CO Emissions: Other Symptoms
Likely to be Present With Each General
Problem Area
Decision Procedure for Excessive HC and CO Emissions

UNIT VI - CARBURETOR ADJUSTMENT PROCEDURES

Learner Objectives
Background Introduction
Carburetor Adjustment
Engine Idle RPM and CO Relationships
Exhaust CO Specification Method of Carburetor Adjustment
Lean Drop Method of Carburetor Adjustment
Propane Enrichment Method of Carburetor Adjustment

APPENDIX A

Propane Enrichment Procedures
Chevrolet - 1978
Chrysler - 1977-1978
Ford - 1975-1978

APPENDIX B

CO to A/F Ratio Conversions
Definition of Terms

APPENDIX C

Demonstration Exercise #1 - Infrared Exhaust Gas Analyzer
Demonstration Exercise #2 - Infrared Analyzer Calibration Check
Demonstration Exercise #3 - Ignition System Problems, HC
Demonstration Exercise #4 - Air Leaks and EGR Problems, HC
Demonstration Exercise #5 - Induction System and A/F Mixture Problems, CO

APPENDIX D

Diagnostic Reference Chart #1: Ignition System Malfunctions
Diagnostic Reference Chart #2: Ignition Timing Defects
Diagnostic Reference Chart #3: Air Leaks or Lean Misfire Condition
Diagnostic Reference Chart #4: EGR System Malfunctions
Diagnostic Reference Chart #5: Mechanical Defects in Engine
Correction Procedure: Excessive HC Emissions
Diagnostic Reference Chart #6: Excessive CO Emissions
Correction Procedure: Excessive CO Emissions
Decision Procedure: Excessive HC and CO Emissions

APPENDIX E

Suggested References
Suggested Equipment/Tools and Materials